

The engine

Both the opponent and the helper players are based on the **MCTS/UCT** algorithm.

The human:

- Chooses which move to play
- Observes the statistics of simulations
- Can limit the actions to be simulated by the MCTS/UCT algorithm

The machine:

- Performs simulations (by building the internal game tree)
- Provides the user with statistics computed for the currently legal actions

Interface

The interface consists of three main windows:

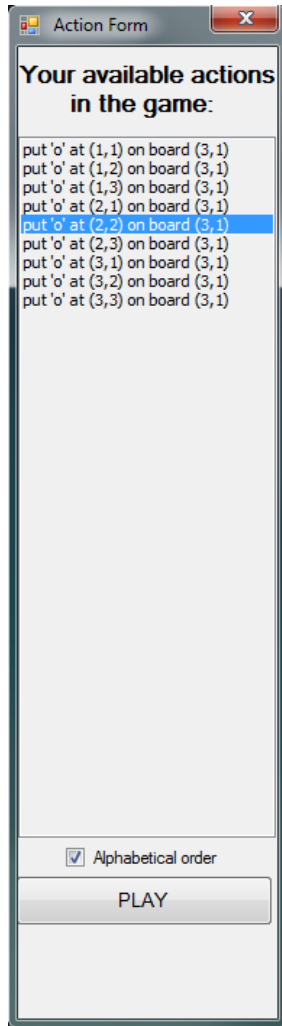
- Action Form:** A window titled "Action Form" on the left. It lists "Your available actions in the game:" with a list of actions like "put 'o' at (1,1) on board (3,1)". The action "put 'o' at (2,2) on board (3,1)" is highlighted. Below the list is a "PLAY" button and a checkbox for "Alphabetical order".
- Game Board:** A central 3x3 grid. The top row is labeled 1, 2, 3 and the left column is labeled 1, 2, 3. The grid contains a black 'X' at (3,2), a black 'O' at (2,2), and a blue square highlighting the cell (3,1). The board is titled "Player1 action = [put 'x' at (3,1) on board (1,2)]. Player2 action = [wait]".
- Statistics/Cooperation Window:** A window titled "Co-operation form" on the right. It shows "Prediction (data from your machine co-operator)" with a table of actions, quality percentages, and simulation counts. It includes buttons for "Enable / Disable Selected Action", "Enable all Actions", and "Disable all Actions". At the bottom, it shows "SIMULATIONS ENDED WITH: [YOUR WINS: 3061] [YOUR LOSSES: 3615]" and a "Simulate" button.

The window for choosing the action

The game board

The statistics/cooperation window

Interface

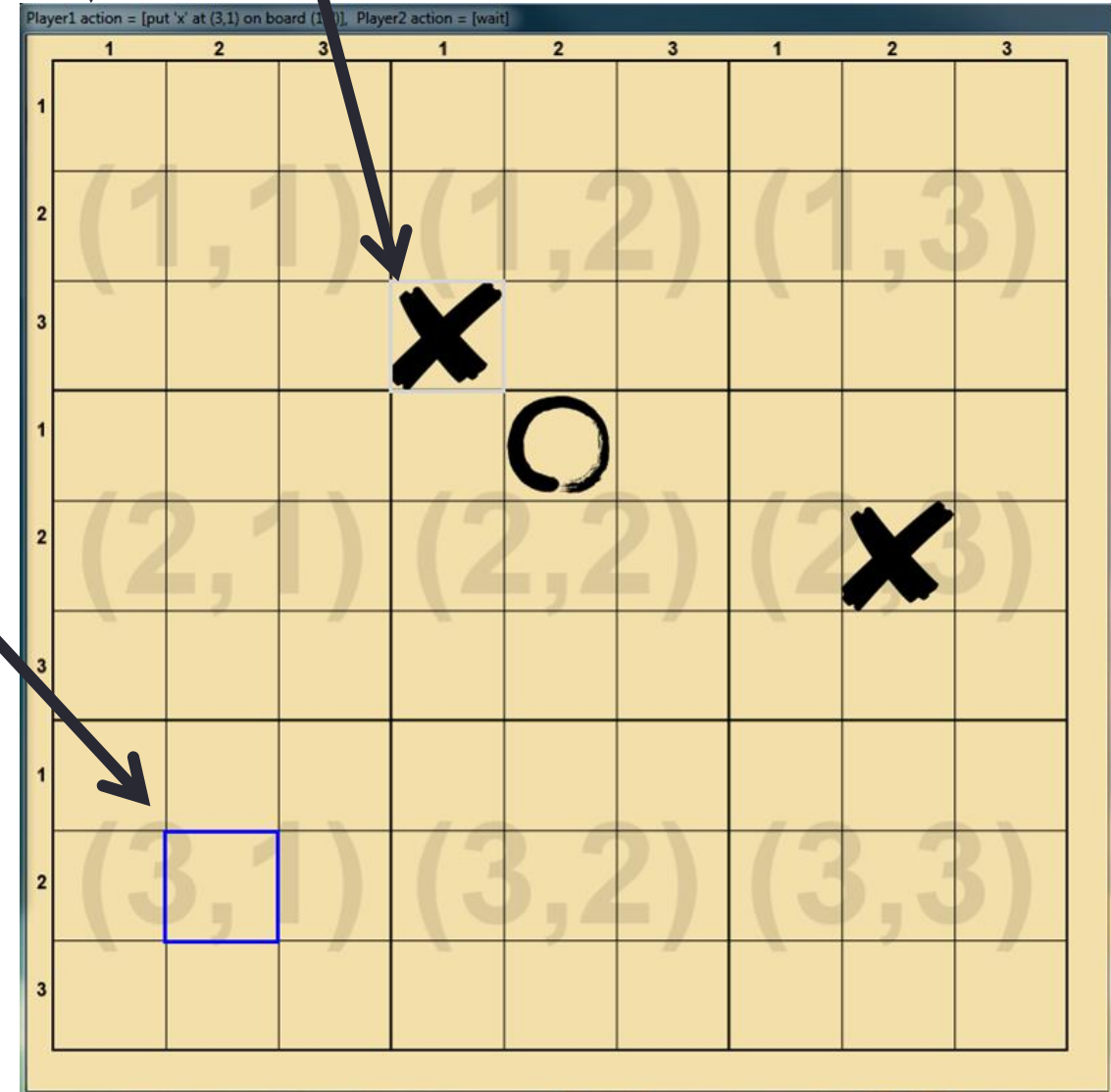


- List of available actions
- On the board, the region related to the selected action is highlighted

During the oponent's turn, the only available action is „wait”. It is not played automatically.

Click this button to **play the action**
(the only option to make a move)

the last performed move (text description and the highlighted cell)



Monte Carlo Tree Search

Your machine helper performs many simulations of what might happen in the game starting with currently legal actions and ending with a win, draw or loss for you. The central part of the co-operation form is devoted to showing you the results of those simulations.

There is a limited number of simulations per step:

- The more simulations, the more confident the assessment Q and, consequently, the stronger the machine helper
- Disabling certain actions from the simulation process increases the confidence of the actions which are enabled (because they will be used more often)

Cooperation:

Statistics for each action :

- **Name of the action** – the selection is synchronized with the left window, upon selection you can see, for example, the fields on the board related to the action.
- **Q** – the assessment computed by simulations.
The bigger the number the better the action:
 - **0** - you are almost sure to lose if you play this action.
 - **50** – the game is a draw or undecided yet.
 - **100** – you are almost sure to win if you play this action.

You can sort actions according to their Q.

- **N** – is the percentage of simulations in which this action was investigated by the machine. Higher numbers denote finer simulated actions.
- The numer of wins, draws and losses (from your perspective) encountered in simulations starting from a given action.

Co-operation form

Prediction (data from your machine co-operator)

WAYS TO INTERACT WITH YOUR MACHINE CO-OPERATOR:

Enable / Disable Selected Action

Enable all Actions

Disable all Actions

(simulations used in the prediction process start only from enabled actions)

SIMULATIONS ENDED WITH: [YOUR WINS: 3061] [YOUR LOSSES: 3615]

Simulate

Simulations left in the current step: 2

[active player action]	[Q: quality (0-100%)]	[N: % of simulations]
[put 'o' at (1,1) on board (3,1)]	[Q: 42,4%]	[N: 11,2%]
[put 'o' at (2,1) on board (3,1)]	[Q: 41,2%]	[N: 10,5%]
[put 'o' at (3,1) on board (3,1)]	[Q: 43,8%]	[N: 12,1%]
[put 'o' at (1,2) on board (3,1)]	[Q: 38,3%]	[N: 9,0%]
[put 'o' at (2,2) on board (3,1)]	[Q: 45,9%]	[N: 13,7%]
[put 'o' at (3,2) on board (3,1)]	[Q: 42,5%]	[N: 11,3%]
[put 'o' at (1,3) on board (3,1)]	[Q: 43,6%]	[N: 12,0%]
[put 'o' at (2,3) on board (3,1)]	[Q: 36,3%]	[N: 8,2%]
[put 'o' at (3,3) on board (3,1)]	[Q: 43,6%]	[N: 12,0%]

Cooperation:

Enable / disable the selected action

Enable all actions (reset)

Disable all actions (useful to next enable on or a few actions)

- Twice per move, you can perform another **batch of simulations** by pressing the **SIMULATE** button
- Before pressing **SIMULATE**, you should decide which actions should be disabled and which of them should be enabled
- Simulations will start only from the enabled actions
- By default, all actions are enabled

The screenshot shows a window titled "Co-operation form" with a table of actions and their simulation results. The table is sorted by quality. The actions are listed in the first column, followed by quality (Q) and number of simulations (N) in the second and third columns. The action "[put 'o' at (3,2) on board (3,1)]" is highlighted in blue. To the right of the table are three buttons: "Enable / Disable Selected Action", "Enable all Actions", and "Disable all Actions". Below the table, there is a status bar showing "SIMULATIONS ENDED WITH: [YOUR WINS: 3061] [YOUR LOSSES: 3615]" and a "Simulate" button. At the bottom, it says "Simulations left in the current step: 2".

[active player action]	[Q: quality (0-100%)]	[N: % of simulations]
[put 'o' at (1,1) on board (3,1)]	[Q: 42.4%]	[N: 11.2%]
[put 'o' at (2,1) on board (3,1)]	[Q: 41.2%]	[N: 10.5%]
[put 'o' at (3,1) on board (3,1)]	[Q: 43.8%]	[N: 12.1%]
[put 'o' at (1,2) on board (3,1)]	[Q: 38.3%]	[N: 9.0%]
[put 'o' at (3,2) on board (3,1)]	[Q: 45.9%]	[N: 13.7%]
[put 'o' at (3,2) on board (3,1)]	[Q: 42.5%]	[N: 11.3%]
[put 'o' at (1,3) on board (3,1)]	[Q: 43.6%]	[N: 12.0%]
[put 'o' at (2,3) on board (3,1)]	[Q: 36.3%]	[N: 8.2%]
[put 'o' at (3,3) on board (3,1)]	[Q: 43.6%]	[N: 12.0%]

Ways to interact with your machine co-operator:

- Enable / Disable Selected Action
- Enable all Actions
- Disable all Actions

(simulations used in the prediction process start only from enabled actions)

SIMULATIONS ENDED WITH: [YOUR WINS: 3061] [YOUR LOSSES: 3615]

Simulate

Simulations left in the current step: 2